The Papua and New Guinea Agricultural Journal

Vol. 11 October, 1956 No. 2

Department of Agriculture, Stock and Fisheries,
Port Moresby

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The
Papua and New Guinea
Agricultural Journal

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The Papua and New Guinea
Agricultural Journal

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POPULATION-LAND INVESTIGATION IN THE CHIMBU SUB-DISTRICT.

J. W. BARRIE *

DURING May, 1957, the writer conducted an investigation into the population pressure-land balance in the Chimbu Subdistrict. It was decided to confine activities to one selected community only. For this purpose the Pagaku Sub-clan within the Kamanegu group in the Central Census Division was selected.

It was endeavoured during the course of the investigation to enquire fully into all factors that were thought to be in any way connected with population and land within the Pagaku Sub-clan community. It was decided to confine respective investigation reports and findings to certain specified aspects of the investigation. In this report it is intended to present the findings of the investigation of the following factors :—

1. Land tenure.
2. Subsistence agriculture.
3. Cash agriculture.
4. Land resources.
   (*a*) Land suitability ; and
   (*b*) Land degredation and soil erosion.
5. Discussion.

Land Tenure.

Land is owned and worked by the individual rather than by the community. However, the proposed sale or transfer of the land of any particular individual is a community affair and the ultimate decision regarding the disposal of the land is a community decision. As a rule land ownership does not extend outside the sub-clan, thus an individual cannot sell or transfer his land or portion thereof to any individual outside his sub-clan.

Land is inherited patrilineally, being divided equally among the male offspring. If the father has no male offspring, then the father's eldest brother inherits the land. In the event of the individual male having no male offspring and no brothers then the land passes to a male relative within the sub-clan.

The patrilineal inheritance of land plus the increasing emphasis towards individual ownership and control is resulting in excessive fragmentation of the arable land. Coupled with an increasing population and growing interest in cash cropping it can be expected that the degree of fragmentation of land will almost certainly result in acute land-population pressure problems arising.

It would appear that the population pressure-land availability balance has not as yet become sufficiently unbalanced or unstable as to cause a general community awareness of the impending problem. Although it is recognized by the Native community that the area of arable land is restricted, there does not appear to be any visible inclination on the part of individuals to move away from the Chimbu region and seek land in other areas. During the course of the investigation the topic of "rural resettlement" was mentioned on several occasions. The immediate reaction by the villagers in every instance was to emphasise emphatically that there was adequate available for both subsistence and cash cropping

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and that every man has ample land for his needs. These statements conflicted rather strongly with the information given when small numbers only of individuals were questioned and when there was no mention of rural resettlement.

All of the arable land owned by the sub-clan has been excessively sub-divided, resulting in a large number of plots of varying size. The smaller plots may be as small as one hundred square yards in total area whilst few plots would be more than one acre in area. The average size of the plots was judged to be in the vicinity of one-third to one-half of an acre.

A small landholder would own perhaps two or three plots, whilst a large landholder may own in the vicinity of forty plots of land.

Very rarely is an individual's total land contained in one single holding. Usually the plots are scattered throughout the community area. Thus a man owning ten plots of land may have a plot in ten different localities within the sub-clan boundaries. Usually this will include some land on the steeper, eroded hillside areas plus some land on the more fertile, lower-lying land. Similarly, a father in allocating land to his respective son includes portions of good land and not so fertile land for each son.

Burial grounds and ceremonial grounds (sing sing grounds) are regarded as communal ground. The forest resources are also regarded as belonging to the sub-clan as a whole, and not to individuals. However, in the event of an individual of the sub-clan having gardens on the sub-clans' forest areas then the production from the garden area is regarded as belonging to that particular individual. Once the garden produce is harvested then the garden area reverts back to the sub-clan land.

Subsistence Agriculture.

The Chimbu region is an area of intensive subsistence agriculture. Every available area of suitable land is utilized for food gardens. There is ample evidence to indicate that with the increasing population pressure-land availability balance the lower margins of the forest land are gradually receding further up the mountain slopes. The lower margins of the forest areas and the higher food gardens lie at about the 8,000 ft. contour.

A noticeable feature of the subsistence agriculture is the inclusion of Casuarina trees in the rotation. The trees are planted in the food gardens at the same time as the planting of the last and second last rotations of the cropping cycle. The Casuarinas are allowed to mature and remain for approximately ten to twenty years. The duration of the period of fallow under the Casuarina cover is determined by the apparent soil fertility and the area of land owned by the individual. A man owning only a small area of arable land naturally cannot afford to be as extravagant as the larger landholder with respect to the length of time that the old garden land is under bush fallow. When the garden land is required again, the Casuarinas are used firstly to construct a pig-proof fence around the garden area. Minor uses include building material and firewood.

Cropping rotations are an accepted part of the subsistence agriculture. The rotations vary according to the apparent soil fertility, drainage, freedom of the area from pig damage, and also depending upon the amount of land owned by the respective individuals. Although the small landholders enjoy usufructuary rights regarding the land owned by the more fortunate larger landholders, it is evident that the small landholder tends to practice a more intensive, soil-exhausting rotation than the individual possessing larger areas of land.

Examples of rotations commonly practised are as follows :—

1. *Rotation on Rather Heavy, Moister Soils.*—

(*a*)

1st Planting	Sugar cane, bananas, pit-pit, beans, cabbages, maize, yams, taro. All planted as a mixture in the food gardens.)
↓	
2nd Planting	Sweet potato, plus maize, beans, cabbage, potatoes. Some Casuarina seedlings planted.
↓	
3rd Planting	Sweet potato, maize, cabbages, beans. More Casuarina seedlings planted.
↓	
	Allowed to remain under Casuarinas for 10-20 years.

(*b*)

1st Planting — Sugar cane and vegetables.

↓

2nd Planting — Vegetables and pit-pit species.

↓

3rd Planting — Sweet potato. Casuarina seedlings planted.

↓

Allowed to remain under Casuarinas for 10-20 years.

If possible, sweet potato plantings are confined mainly to the well-drained soils.

2. *Rotation on Friable, Free Draining Soils. Less Depth of Topsoil than in* (1).—

Good drainage may be as a result of free-draining soils or steepness of slope.

1st Planting — *Sweet potato.* A mixture of maize and vegetables planted in the sweet potato gardens.

On the higher slopes, 6,000-8,000 ft. sweet potato makes very slow growth.

↓

2nd Planting — *Sweet potato.* If the grower has sufficient land the garden is abandoned after the 2nd planting.

↓

3rd Planting — *Sweet potato.* In extreme cases a fourth sweet potato planting. The tubers are small and used mainly for pig food. Some Casuarinas planted.

↓

Grass or bush fallow. Allowed to remain for 10-20 years.

Casuarinas are planted in the last and second last years of the rotation. Very few Casuarinas grow to maturity on the steep, exposed slopes due to the rather dry soils. Normally a mixed grass flora covers the old garden areas.

It is preferred to grow the sweet potato on the shallower, better drained soils on the steep slopes. Although the tuber size is smaller, the tubers are firmer as they do not contain such a high moisture percentage. The keeping quality is also superior to that of tubers grown on the moister, heavier soils.

On the higher altitude slopes, from 6,500 ft-8,000ft., sweet potato matures much more slowly, and may take from twelve to eighteen months to mature. In such areas usually only one planting of sweet potato is made. The garden land is then allowed to revert to secondary bush or grass cover.

Yams, taros, vegetables and sugar cane are usually grown on the deeper, moister soils in the lower-lying areas. Several species of edible Pandanus growing in the forest regions are an important additional dietary supplement at certain times of the year.

Although Casuarinas are usually planted in all garden areas prior to the end of the cropping cycle it is most evident that very few of the Casuarina seedlings survive to maturity on the steeper slopes, with rather shallower soils and exposed to drying winds. It is rather common to see gardens on slopes of 40-50 degrees inclination. On these slopes clumps of Casuarinas are more usually found in the depressions and gullies. On the exposed, eroded slope faces only scattered individual Casuarinas are noticed.

On the low-lying areas, dense stands of Casuarinas cover most of the old garden land.

Efforts are made to retain the surface soil on the steeper slopes by terracing and the construction of timber retaining walls running across the slope. Where the soils are not so friable or free-draining, an extensive system of lateral and vertical drains constucted to facilitate a quick dispersal of surface water and to prevent the garden land from becoming overmoist for extended periods are a common feature of the food gardens.

When preparing new garden land the surface vegetation is cleared and burned on the proposed garden areas. The ashes are dug into the soil as the ground is broken up in readiness for planting. The partly prepared land is then allowed to lie for some weeks prior to planting. It is recognized that if new ground is turned over and planted immediately then poorer crop yields will result, in comparison with the yields obtained when the turned soil is allowed to lie fallow for some time prior to planting.

Quite heavy food losses result from the constant damage caused by the depredations of the marauding pig population. Hence it is noticeable that in areas that are inaccessible or otherwise free from pig damage, that these areas are cropped intensively with extended soil-exhausting

rotations. Although the pig population varies from time to time depending upon the recurrent disease outbreaks and the mass-killing of pigs for certain ceremonial occasions, the pig population for the Pagaku sub-clan at the time of the investigation was judged to be approximately five pigs per head of male population. The writer was led to understand that a much greater population of pigs is usual.

The planting of food crops is continued throughout the year, without there being any definite planting season. There does, however, appear to be a general slackening-off in planting of sweet potato gardens shortly after the commencement of the wet season —usually early in November. During this period more time is devoted to the cleaning and weeding of the established sweet potato gardens and to the planting of subsidiary food crops including yams, taros, vegetables and sugar cane.

The accepted custom with the planting of sweet potato which constitutes at least 90 per cent. of the diet, is that a general concerted planting of sweet potato occurs shortly before the wet season is expected to end. This planting effort usually occurs during the months of March and April. General planting of sweet potato then continues throughout the year until about early November. Even during the dry months of June, July and August, various individuals will continue planting depending upon their needs, although it is obvious that on the steeper slopes, the sweet potato plantings make little appreciable growth during the dry months.

Serious food shortages do occur from time to time. However, there does not appear to be any definite time or period when shortages may be expected. Nor does there appear to be any one definite contributing cause for the recurrent shortages. Food shortages are known to occur in the wet season as well as in the dry season. However, the food shortages are not of an extended duration, usually about two months as a rule, and do not occur over an extended area. Contiguous tribal groups may not have food shortages at the same time.

Unexpected periods of dry weather are a contributing cause of food shortages on some areas. Ceremonial occasions when there is a slackening-off in the planting of food gardens may also be a contributing food shortage factor. Perhaps the most significant factor influencing the time and duration of food shortages are periods of plenty when there is an abundance of food for all. This may occur as a result of a rather favourable season, or perhaps as a result of concerted earlier plantings resulting from an earlier food shortage.

In such times of plenty an atmosphere of complacency is apt to pervade the community. Very little planting of food gardens is carried out whilst the complacent attitude prevails. Fortunately this short-sighted perspective usually does not last for perhaps more than two months. It is then replaced by a period of haste and hurried plantings.

Medical investigations in the Chimbu regions have indicated that the diet of the Chimbu people is composed of an excess of carbohydrate and a deficiency of protein. At the Native hospital at Kundiawa more deaths are recorded among babies and young children from diseases associated with protein deficiency than from any other single disease. The aetiology for these diseases is directly connected with the excess carbohydrate-protein deficient diet of the people.

The large pig population does not contribute towards alleviating the protein deficiency as the pigs are reserved mainly for ceremonial occasions when large numbers of pigs are slaughtered.

Cash Agriculture.

Cash agriculture among the Chimbu people especially with respect to permanent tree cropping, will be restricted by the relatively small area of the total arable land suitable for tree cropping.

At the present time the sale of vegetables, sweet potato, coffee and peanuts are the main avenues for cash cropping. The uncertain market position regarding increased passionfruit production in the highlands has meant that there has been no active programme to extend Native passionfruit plantings.

It is the opinion of the writer that the pressing population pressure-land availability balance in the Chimbu region would suggest that passionfruit production as a major crop is peculiarly suitable, there being an ade-

quate and stable market for increasd Territory production of passionfruit. The native fashion of planting the vines to trail through the trees has proved very successful. Passionfruit can thus be grown quite successfully with a minimum of labour and effort wherever there are established Casuarina trees. Hence appreciable areas of productive land need not be utilized for cash cropping as in the case with the alternative cash crops, coffee and peanuts.

Native coffee production will be limited to individuals having sufficient reserves of suitable land to allocate to a permanent cash crop. It is not to be expected that usufructuary rights between the large and the small landholder will encompass the planting of cash crops, particularly tree crops which are of a permanent nature. Thus in time as the large landholder has his land reserves progressively decreased by increased fragmentation and more land is utilized for cash cropping, it is possible that usufructuary rights with respect to food gardens may become progressively restricted. This could in turn result in the smaller landholder, with insufficient land for economic cash cropping, deciding to move elsewhere in an endeavour to find sufficient land for profitable cash cropping. It would appear then that in time economic necessity may force migration and rural resettlement for part of the population, unless other large-scale avenues of suitable employment and settlement become available.

The Chimbu Native in common with other Highland Natives is becoming increasingly aware of the necessity for some avenue or source of cash income. Naturally enough, coffee is regarded as the vehicle or quickest means of achieving this end. Whilst high coffee prices remain, one cannot expect any diminishing interest in coffee culture on the part of the Native landholder. Dissatisfaction rather than waning interest is more liable to accrue in cases where there is insufficient suitable land for coffee production. The answer to this problem for the present may be to focus attention on alternative cash crops, preferably of an annual or semi-permanent nature. Peanuts and passionfruit fall into this category. The uncertain marketing position with respect to unlimited passionfruit production has already been discussed.

To date the fostering of peanuts in the Highlands as a cash crop and a subsidiary food crop for the Native community has been rather successful. Although the peanut market is at times an unstable one, for Territory produced peanuts, there are the advantages that when a profitable market is available the Native grower has the opportunity of reaping a quick monetary return from his land as the peanuts can be grown as one rotation in the cropping cycle of the subsistence agriculture. This has in fact become a noticeable feature of the subsistence garden in the Chimbu region. Also should the market fail to come up to expectations then the peanut crop can at least be consumed by the villagers. The increased consumption of peanuts by the Native population has become quite considerable over the last two years. Peanuts now constitute an important role as a subsidiary food crop, plus a most important protein dietary supplement.

It is thought, however, that in areas similar to the Pagaku sub-clan community, and possibly the majority of the populated Chimbu region, in which there is a possible unstable population pressure-land availability balance, that as the Native landowner becomes progressively more advanced, both economically and socially, then the need will be for a cash crop, preferably of a permanent nature, with a potentially high monetary return per unit area. It is axiomatic that coffee would appear more suitable in this respect.

Land Resources.

(a) Land Suitability.

Of the total area of land owned by the Pagaku sub-clan it is estimated that 70-80 per cent. of this is suitable for the present type of agriculture. This includes cultivating 45-50 degree slopes. The land unsuitable for the present-type agriculture consists mainly of precipitous limestone cliffs and numerous limestone outcrops.

The soil fertility pattern appears to be closely correlated with the duration and variety of the cropping rotation plus the extent to which Casuarinas are planted at the completion of the cropping cycle. On the terraces and lower-lying areas, with deeper soils and moister conditions, there is no evidence to suggest that the soil fertility is being depleted. As illustrated in the

rotation examples cited, there is a greater variety of food crops incorporated in the rotation on the soils in the lower-lying areas. Usually the cropping cycle is completed after the harvesting of the third crop. The old garden land then being thickly planted with Casuarinas.

On the steeper, well drained, limestone slopes and terraces, it is equally evident that a gradual degradation of soil fertility is occurring. Erosion, a soil-exhausting sweet potato cropping cycle, plus the fact that very few Casuarinas survive on the old exposed garden sites are complementary agents of soil fertility depletion.

Sections of the higher limestone slopes are protected from pigs by encircling limestone cliffs and escarpments. It is most noticeable that such protected areas are being subjected to almost continus cropping. Soil erosion and soil degradation are the resultant concomitants.

(*b*) *Soil Erosion.*

Soil erosion is apparent rather than appreciable. One sees more evidence of gradual sheet or surface erosion than of gully erosion.

Erosion occurs more during the short period of fallow between the harvesting of one crop in the rotation and the planting of the succeeding crop. Marauding pigs are active agents in accelerating erosion on fallowed land.

On the deeper and more friable soils on the steep limestone slopes, erosion is most serious in times of very heavy rainfall. The resultant quick run-off of a large volume of water may cause extensive sheet erosion, especially on fallowed land.

Heavy clay soils derived from mudstones are common on the higher ridges. Although gardens on these soils usually have an intricate network of drains, serious loss of surface soil may result in times of heavy and rapid run-off. Unlike the free-draining soils, the mudstone soils overlie heavy clay subsoils, thus a greater volume of run-off scours out the ground on the mudstone soils.

On the steeper limestone slopes, wooden or stone retaining walls are sometimes constructed across the slope as soil conservation measures. Certain shrubs, in particular the *Cordyline sp.* are planted in lines across the slope to form a permanent soil-retaining wall. Both of these measures are successful to a degree.

As mentioned previously, on the mudstone soils an extensive network of lateral and vertical drains are constructed between the gardens to facilitate a quick run-off of excess surface water. Although the vertical drains tend to scour out it is most noticeable where these drains are inadequate or have not been constructed on the heavier textured soils, that in times of heavy rain the whole garden area is liable to slip down the mountainside. Several areas were noticed in which the area of slipped land was at least three acres in area. Once the land has slipped it becomes very susceptible to rapid sheet and gully erosion.

Discussion.

The Pagaku sub-clan is a relatively densely populated community practising the traditional shifting cultivation rotation in its subsistence agriculture. Impinging of late upon this balance are the factors of gradual population increase, increased fragmentation of land the introduction of cash cropping. The cumulative effect of these forces would appear to be creating an unstable population pressure-land availability balance.

It is difficult to conceive that the practice of shifting cultivation can ever support a dense population permanently. Rather it would seem that the continuance of a shifting cultivation for a subsistence agriculture would demand a static population and in some cases a decreasing one. Within the Chimbu region one is faced with the positive and negative factors respectively of an increasing population and to a certain degree a decreasing land potential.

On the positive side it is inconceivable than an increasing population of traditionally subsistence agriculturists now on the threshhold of social and economic advancement can hope to attain a higher standard of living, both socially and economically whilst maintaining the traditional bush-fallow system of agriculture. Rather it would seem desirable that some gradual change-over be effected from the extravagant shifting cultivation to a more intensive system of rotational agriculture. Alternatively rural resettlement, if and where possible, offers

another avenue of social and economic advancement for the native communities so affected.

With reference to the negative factor of diminishing land potential there is ample evidence to illustrate that on the steeper slopes the practice of shifting cultivation is resulting in soil loss and soil nutrient depletion. Crop yields are decreasing, denudation is apparent, loss and degradation of the soil is widespread.

The seriousness or erosion due to run-off and scour during periods of heavy rainfall cannot be ignored. Its continuance means that the land on the steep slopes is being denuded and rendered unproductive.

The land resources of the Pagaku sub-clan community consist mainly of steep, hillside slopes and to a lesser extent, lower-lying more fertile land along the river valleys. It is estimated that at least 65 per cent. of the land at present utilized by this community for their farming should not be cultivated due to the steepness of slope and the absence of effective soil conservation methods. From the point of view of soil conservation it is considered that much of the hillside land should be under some form of permanent vegetative cover. Either a timber species or a suitable soil-retaining grass species. Although this offers a possible solution to the pressing problem of land conservation it is hardly compatible with the attainment of social and economic progress by the present increasing population.

Basically then a situation exists in which there is an increasing community population on the verge of social and economic advancement but possessing only static or diminishing land potential. Cash cropping appeals as the vehicle for advancement at the expense of utilizing the best of the land resources. It would thus seem that the problem resolves itself into one of two alternatives. Namely that either additional land resources be secured for the Pagaku sub-clan in juxtaposition to the present land owned by the community, or alternatively that part or all of the Pagaku sub-clan community be resettled in an area where there is ample reserves of suitable land for their requirements, for both subsistence and cash agriculture. The density of population of the Chimbu area as a whole precludes the former alternative. Rural resettlement thus remains as the possible alternative.

It is not to be expected that at this early stage of social development that the people of the Pagaku sub-clan would welcome the idea of rural resettlement. Economic pressures have not asserted themselves to a degree to weaken the traditional bonds that link the native land owner to the land of his forefathers. It may happen, however, that the expansion of cash cropping itself, perhaps more than any other single factor, coupled with the social advancement of the community will tend to create a general awareness in the native community as to the limits of their social and economic advancement whilst they remain on their sub-clan land. When this stage of community awareness eventuates, it is not difficult to conceive that the Pagaku people themselves realize that resettlement for some members of the community will offer perhaps the only way to a better standard of living.

THE REMOVAL OF COFFEE MUCILAGE BY MEANS OF CAUSTIC SODA.

SEVERAL alkaline compounds are known to remove the mucilage from pulped coffee beans. During the last year the Department of Agriculture, Stock and Fisheries has conducted experiments, first on a small scale in the laboratory and later with bulk lots of pulped coffee in the field, to determine whether it is practicable to use caustic soda (sodium hydroxide) to remove mucilage chemically as an alternative to the normal process of fermentation.

In these experiments it was found that the concentration of the caustic soda solution was less important than the total quantity of the chemical used. One pound of caustic soda was sufficient to remove the mucilage from 200 lb. of freshly pulped beans in about fifteen minutes, provided the mixture was suitably agitated. A greater quantity of caustic soda did not accelerate the process and it was obvious that the excess alkali was not used. Smaller quantities of the chemical did not remove the mucilage completely and at the same time inhibited natural micro-biological fermentation.

For practical use of this technique by the planter, the pulped cherry should be just covered with a solution containing 1 lb. of caustic soda for each 200 lb. of pulped coffee (equal to approximately 400 lb. of cherry) and the mass agitated for fifteen minutes with wooden paddles. By this time all the mucilage should have been loosened. The end point can be eternined in the usual way by rubbing the beans between the fingers. They should, of course, feel sandy rather than slimy. Thorough washing must follow.

A point which arises is the possible effect of the use of caustic soda on quality. In laboratory experiments the beans were hand pulped and each sample was then divided into two portions. Before processing, one portion had 10 per cent. of the beans nicked right through the parchment into the cotyledons to simulate pulper damage. The duplicates were processed with caustic soda without further treatment, and samples from the same batch of cherry were fermented by normal methods. Trade testers were unable to find any difference between the samples produced by any of these methods. These results have been fully confirmed with larger samples pulped in the ordinary way with a normal incidence of pulper damage. It thus seems that there is no adverse effect on quality when this technique is used.

The main value of caustic soda demucilaging might be to assist the handling of a flush crop when the amount of cherry coming in is too great for the normal capacity of the fermenting vats. Provided adequate water is available for washing coffee after demucilaging, there seems to be no reason why the technique should not be used in plantation practice. Over a long period the caustic soda might have a slight deleterious action on the concrete vats normally used for fermentation, but, provided the right strength is used, the effect should be very slight.

SOME INSECTS OF CYCAS IN NEW GUINEA

By J. J. H. Szent-Ivany;(1)
J. S. Womersley;(2) and
J. H. Ardley.(3)

NOT much was known in the past of insects associated with *Cycas* plants, which are quite often planted in tropical ornamental gardens. R. Lepesme (4) recorded the Coccid *Hemiberlesia lataniae* Sign. (4. p. 208), *Duplachionaspis inday* Banks (4. p. 238), *Fiorinia fioriniae* Targ. (4. p. 242), *Saissetia hemisphaerica* Targ. (4. 251) and some weevils of the Genus *Rhynchophorus* as pests of *Cycas*. Kalshoven (3) mentioned two Coccids (*Aonidiella aurantii* Marsh, *Leucaniodiaspis azadirachtae* Gr.) a Lycaenid (*Catochrysops pandava* Horsf.) and the Asiatic Rhinoceros Beetle (*Oryctes rhinoceros* L.) damaging *Cycas* in Indonesia.

The common *Cycas*, *Cycas circinnalis*, s. sp. *papuana* (F. Muel.) Shuster, is widely distributed in the mainland of New Guinea. To the best of our knowledge, nothing has been recorded so far of insects associated with this plant in the Territory of Papua and New Guinea.

During July, 1956, it was noticed between the Erap and Ramu Rivers, Markham Valley, that *Cycas circinnalis* was being completely defoliated by larvae of the Lycaenid butterfly *Chilades cleotas*, s. sp. *kaiphas* Fruhst. together with the larvae of a saw fly.

Butterfly larvae pupated and adults emerged but the saw fly larvae were not reared successfully.

Heaviest infestation was occurring on *Cycas* plants which have been recently burnt and were carrying a crown of succulent foliage although feeding was also taking place on mature leaves. In no case was a palm seen where both the *Chilades* larvae and the saw fly were feeding together. Fig. 1 shows the larva of *Chilades cleotas* and Fig. 2 shows the saw fly larva with the typical injury of the insects to the leaves of *Cycas*. A severely damaged *Cycas* plant by *Chilades cleotas* is seen on Fig. 3.

The slow flying adults of *Chilades cleotas* show a remarkable sexual dimorphism, which is so typical of many Lycaenids. The upper surface of the wings of the males is dark blue and they have a large, reddish-orange coloured transverse band before the anal portion of the hindwings. The transverse band is somewhat larger on the hindwings of the females and the blue parts of

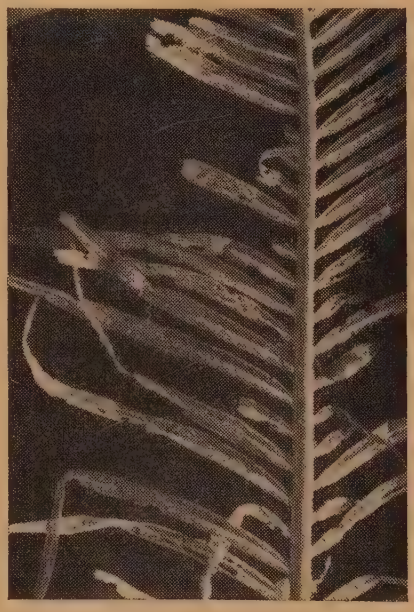

Fig. 1.

the wings—in the case of s. sp. *kaiphas* Fruhst.—are darker blackish-blue, the centre of the forewings being more blue and the marginal parts more black. (see 6, plate 152.)

Chilades cleotas has several closely related geographical varieties (s. sp.) in the Territory of Papua and New Guinea and on some adjacent islands (6, p. 927). The name-form *Chilades cleotas cleotas* is known from the Bismarck Archipelago. The lower sur-

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(3) Entomologist, Agricultural Experiment Station, Bubia, New Guinea.

face of a male specimen of the name-form is seen on Plate I (Fig. *d*). The New Guinea Mainland form, *Chilades cleotas kaiphas* Fruhst., is distinguished by a very broad reddish-orange transverse band on the hindwings. The sub-species has very typical specimens in the Morobe District. Fig. *a* and *b* of Plate I, shows the upper and lower surface of the male and Fig. *c*, the upper surface of the female of the race, found on Bougainville Island.

Szent-Ivany found *Chilades cleotas* in large numbers in the ornamental garden of Mr. C. Sandford at Numa Numa Plantation, where the adult butterflies were mainly attracted by the bright coloured blossoms of bougainvillea shrubs. In 1955 Szent-Ivany found this species in many places between Kavieng and Namatanai along the East Coast of New Ireland. It was very frequent in the ornamental garden of Mr. C. Bat at Kapsu Plantation. Many adults were observed in July, 1955, at Tomalabatt Coconut Plantation at Tatau Island in the Tabar Group.

So far no damage was recorded to *Cycas* by the above-mentioned insects apart from the observation in the Morobe District, but the defoliation of *Cycas* plants in this area was extremely severe. It is thought that the repeated heavy attack of these two insects could exert some measure of control on *Cycas circinnalis* and further observations should be made in this direction in other parts of the Territory.

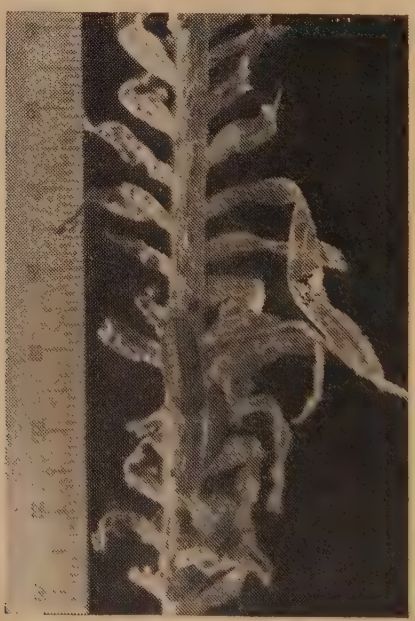


Fig. 2.

Fig. 3.

Four other insects, a Pyralid, a leaf beetle and two small Curculionids were found by Ardley causing injury to *Cycas circinnalis*, all of them in the Morobe District.

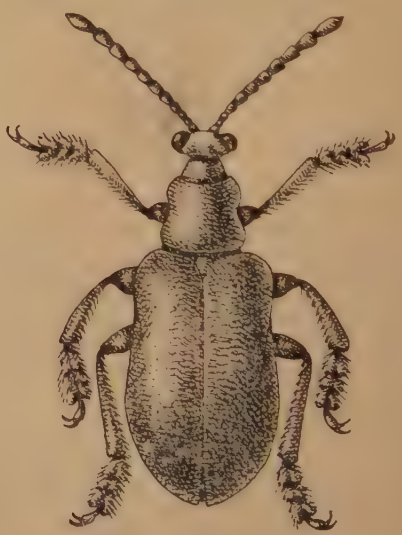
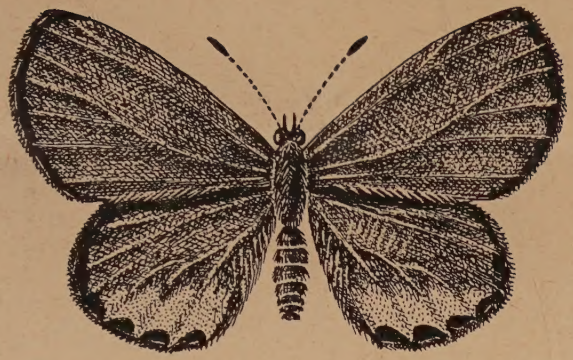
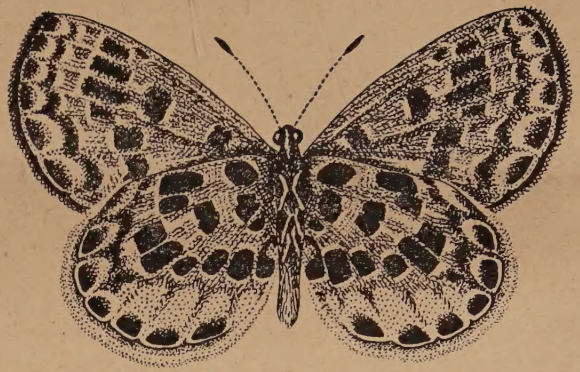


Fig. 4 (x5).

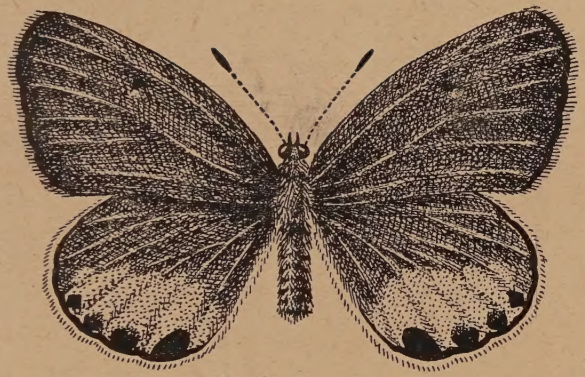
PLATE I.



a (x2).



b (x2).



c (x2).

d (x2).

The Pyralid, *Calguia defiguralis* (Walk) (Det. W. H. T. Tams) was observed attacking *Cycas* at Nadzab in August, 1956. The larvae were found in the bases of the petioles, particularly in the young fronds in the centre of the plant, and the webbing and faeces formed a thick protective mass with the larvae actively feeding beneath.

The Leaf Beetle *Crioceris clarkii* B. Baly var. ? [See Fig. 4 (Det. G. E. Bryant)] a pest of *Cycas* seems to have a large area of distribution in the Morobe District. It was found in large numbers at Nadzab and also at Mumeng along the road to Bulolo and it is beileved that this Criocerid is widely spread throughout the length and the breadth of the Markham Valley. The larvae were seen congregating on the newly unfurled fronds of *Cycas* plants in a manner characteristic of many leaf beetles. They hide under a mass of faeces which sticks to the recurved spines of the dorsal surface of their abdomen. *Crioceris clarkii* usually attacks new growth after bush and grass-fires.

The Genus *Crioceris* is cosmopolitan, Essig recorded 148 named species in 1942 (1, p. 595). Two species (*C. asparagi*) (Linne) and *C. duodecimpunctata* (Linne) are well known pests of *Asparagus* spp. in Europe and they were also introduced to the United States (5. p. 550-551).

The two small Curculionids are species of a Genus which is not represented in the British Museum. Both attack the male cone of the *Cycas* and eat out the central axis of the cone. Ardley found the weevils on newly emerged cones digging their way in and feeding on a sticky exudate on the outside. All mature cones are a mass of weevils inside the central axis and aMicro-hymenopterous parasite and a predatory Histerid beetle were found associated with them.

The parasite was identified by Mr. R. D. Eady of the Commonwealth Institute of Entomology as *Eupelmus* sp. and the predatory Beetle was identified by Mr. Bryant as *Platysoma condylum* Marshall.

The writers are much indebted to Dr. W. J. Hall, the Director of the Commonwealth Institute of Entomology, to Sir Guy Marshall, Mr. W. A. T. Tams, Mr. G. E. Bryant and Mr. R. D. Eady of the British Museum, London, for identification of insects. Also to Mrs. M. L. Szent-Ivany for the drawings.

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